

AR Europe Produce Bespoke Test System For High Current RF Testing Applications

AR Benelux was recently presented with a unique and interesting challenge. One of their customers wanted the ability to test the RF current breakdown of the components they used (capacitors, PIN-switches, RF connectors etc.) at levels of >50A rms. The reason for this was many of these components were poorly or simply not rated with respect to the maximum RF current they can handle.

Not only did the customer want to perform tests at this level they were also looking for a way of achieving this with their existing amplifier which rated at 30kW pulse could only produce around 24A in a conventional 50Ω system!

For this AR Benelux designed a bespoke solution, allowing the customers R&D department to optimise the overall reliability of their designs, exceeding the 50A requirement.

In the basic concept, a ¼ wavelength transformer brings down the 50Ω output impedance of a 30kW RF pulse amplifier to 5Ω. A special 5Ω RF load build up as an array of 20 parallel connected 100 Ω resistors utilises a star-design of ten 50 Ω transmission lines to assure broadband operation.

After the impedance transformation, the current increases from

$$\sqrt{\frac{30000}{50}} = 24.5A \text{ rms}$$

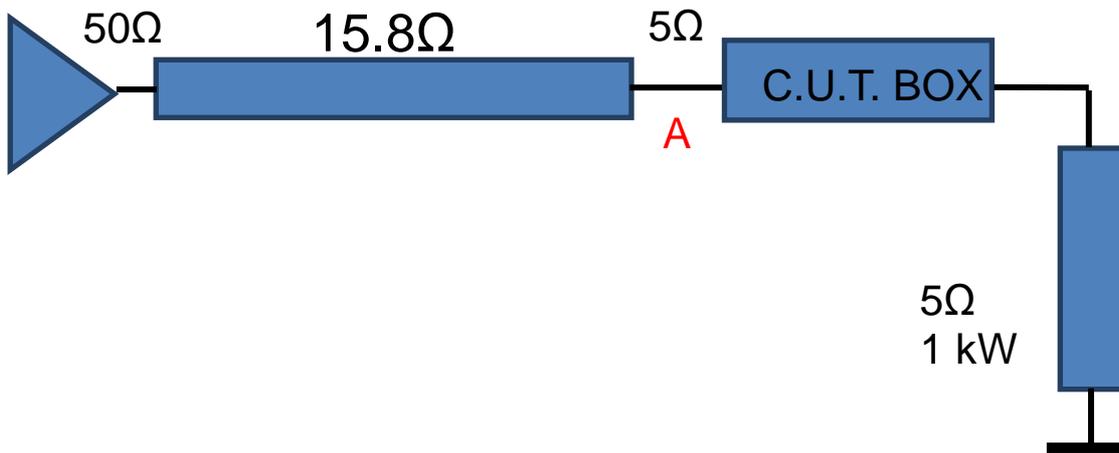
to a higher current in a 5 Ω circuit of

$$\sqrt{\frac{30000}{5}} = 77.46A \text{ rms}$$

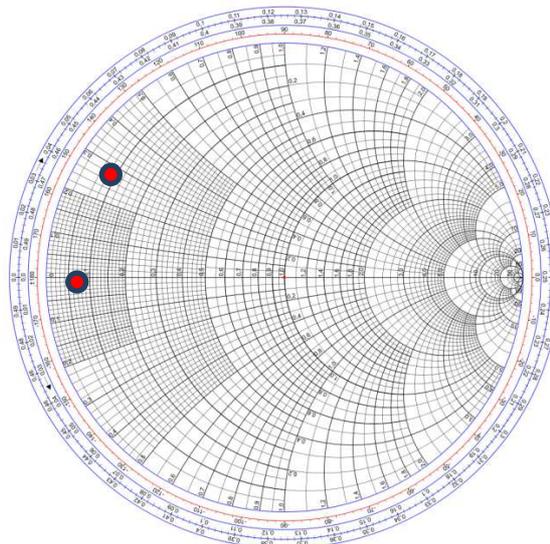
The impedance of the quarter-wave transformer section is derived from the following transmission line theory formula

$$Z_{1/4\lambda} = \sqrt{50 * 5} = 15.81 \Omega$$

When this theoretical approach is implemented, the effect of parasitic effects is not taken in to account. This will become clear as we take a closer look to the set-up.

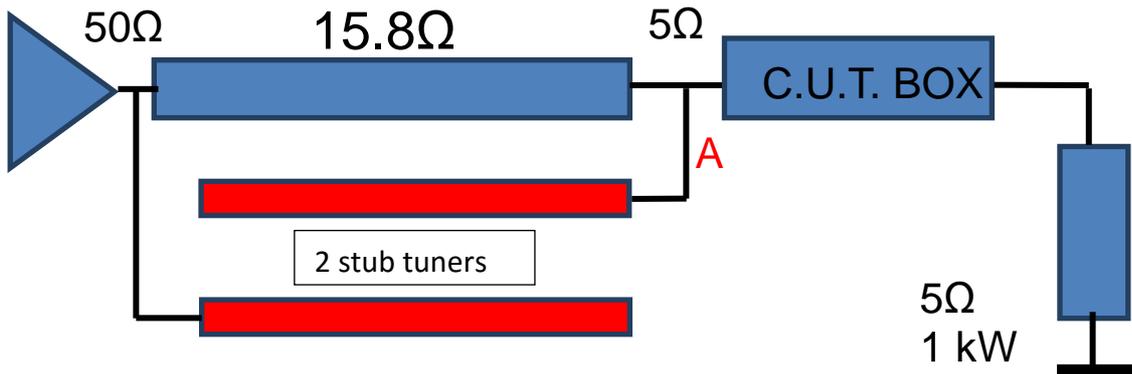


The C.U.T. (Component Under Test) is placed in an RF screened CUT enclosure, where additional physical lengths of connecting wire run between the component and the input/output of the test box. These additional electrical lengths move the impedance of point A to a new position on the Smith Chart where the impedance is $5 + j\omega L$, where L is the parasitic inductance of the connection wires.

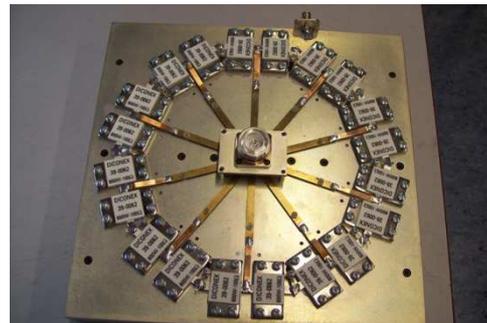


A result from the shift of the load-impedance is that after transformation through the $\frac{1}{4}$ wave line the impedance presented to the amplifier deviates from 50Ω . The impedance mismatch hinders the efficient transfer of power and even makes the amplifier to enter a standby status when the max VSWR is larger than 1.2.

The solution to solve this unwanted effect, while maintaining a low-loss system, was the addition of two shorted or open stub-tuners to both sides of the 1/4 wavelength transformation section.



Transformers and tuners



Custom made 5 Ohm RF load

The test system, affectionately known as “Onno’s RF Trombone” proved to be a very effective solution to the customers problem and was recently presented at the HF Technologies Conference in Eindhoven, where it received a great deal of interest.

In addition to this AR Benelux has quoted for a High Voltage Test solution, to test low value capacitors up to 16kV RF.

For more information on this system or to discuss any similar application requirements please contact Onno de Meyer at AR Benelux – odemeyer@arworld.us